Water Standards

- Define "acceptable" levels of pollutants
- Specific to intended water use
- Example – coliform bacteria
  - 0 per 100 ml in drinking water
  - 2,000 per 100 ml in swimming water

Units

mg/L = ppm

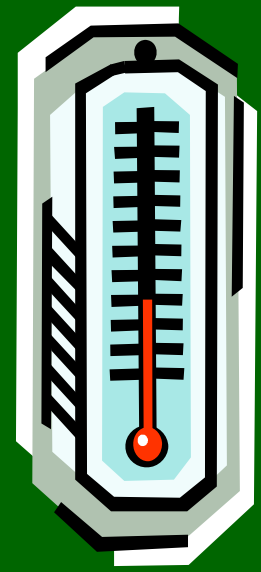
μg/L = ppb

Physical Measures

Stream Flow

Turbidity / Suspended Sediment

Temperature



- Generally increases with stream size and open water area
- Determines aquatic biota
- Small changes are critical
- Strong correlation with dissolved oxygen

pH

- Good indicator of natural water quality
- Important for aquatic life
- Sandstone/Shale watersheds ~6.0 to 7.0
- Limestone watersheds ~7.0 – 8.0
- Impacted by acid rain, mine drainage

Conductance
Total Dissolved Solids (TDS)

- Measures amount of ions dissolved in the water
- Naturally higher in more productive streams
- Good general water quality measure

Alkalinity

- Measure of resistance to pH change
- Comprised mostly of Ca, Mg, Na, K
- Good indicator of productivity
- High in limestone streams, lower in headwater areas
- Sometimes measured as Acid Neutralizing Capacity (ANC)

Other Chemical Parameters

BOD

-Oxygen demand from decay

Nutrients

-Nitrogen, Phosphorous

Metals:

-Al, As, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Ni, Zn

-naturally low

-increase with acidification or land use change

Biological Parameters

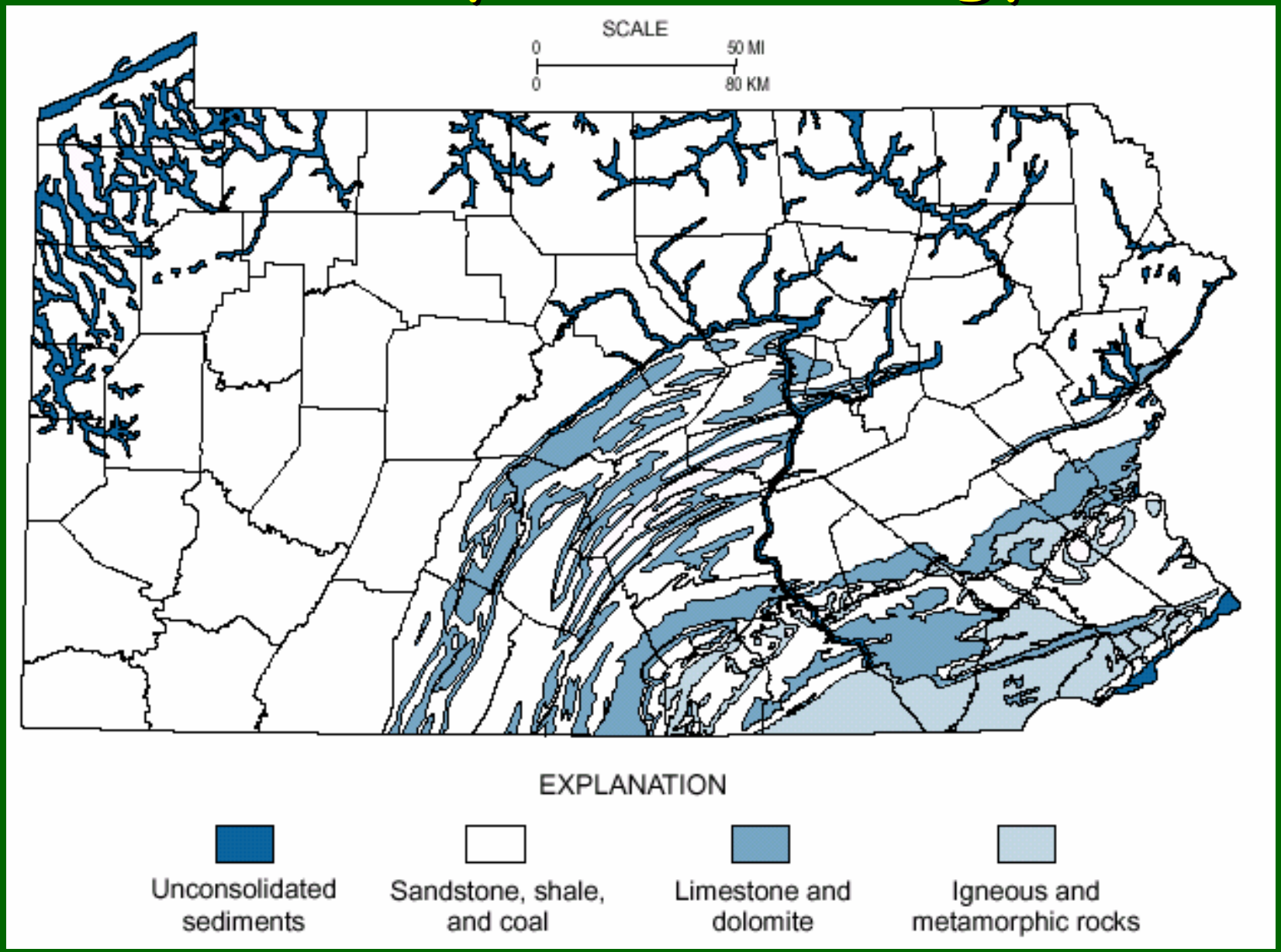
Good barometers of water quality!

- Bacteria
- Macroinvertebrates
- Fish

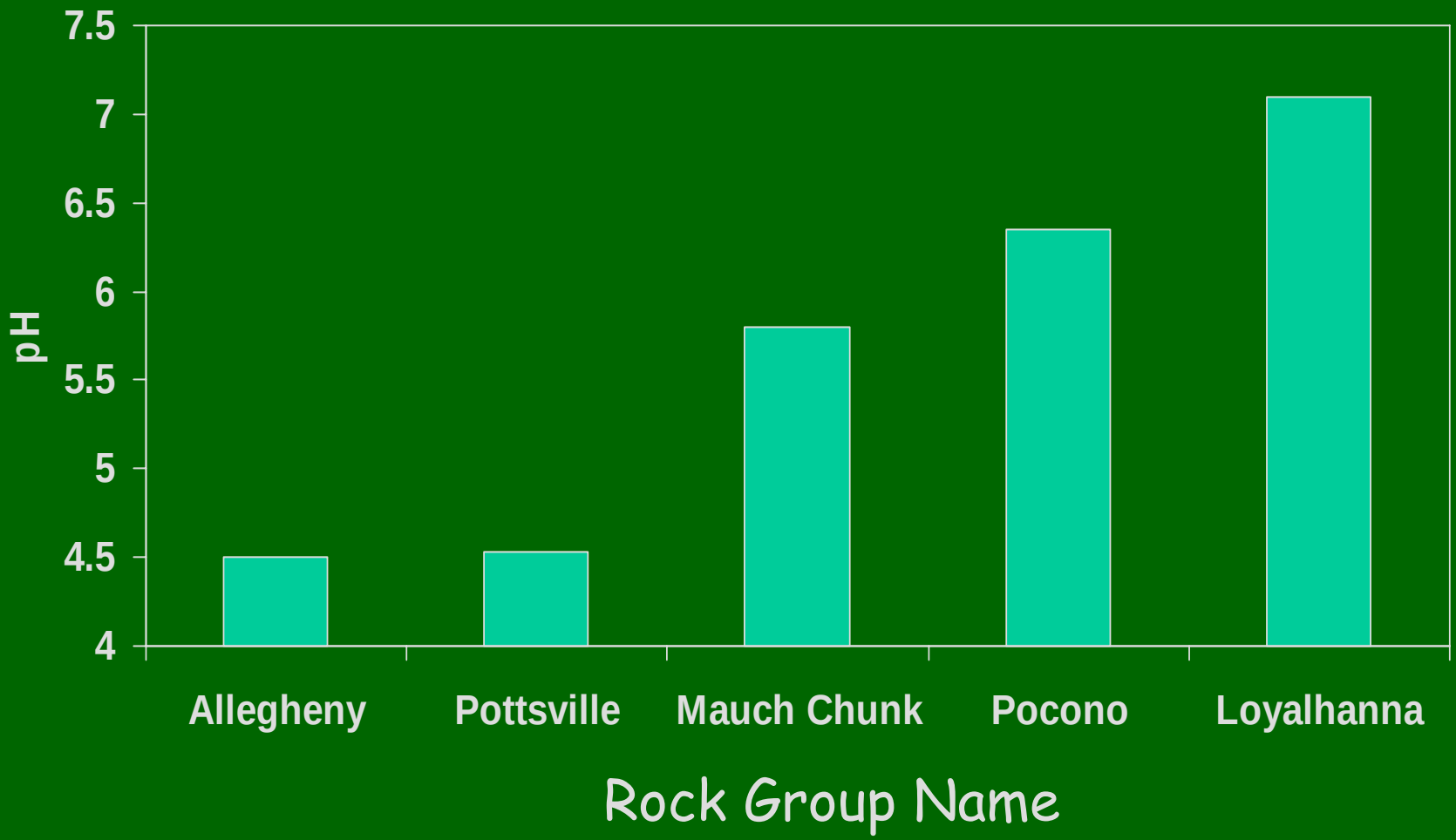
Controls on Water Quality

- GEOLOGY
- Air Deposition
- Hydrology

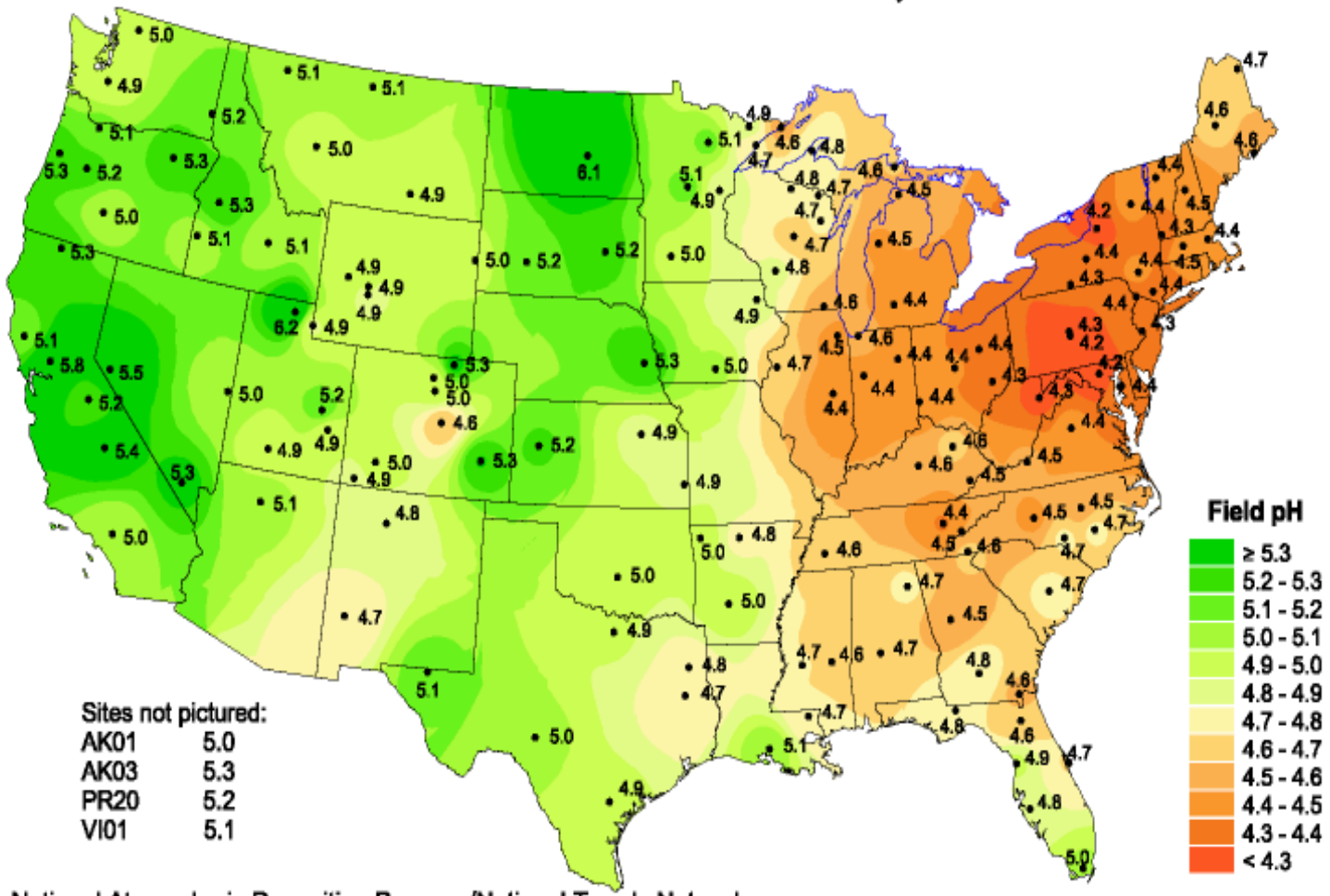
Pennsylvania Geology



Groundwater Chemistry

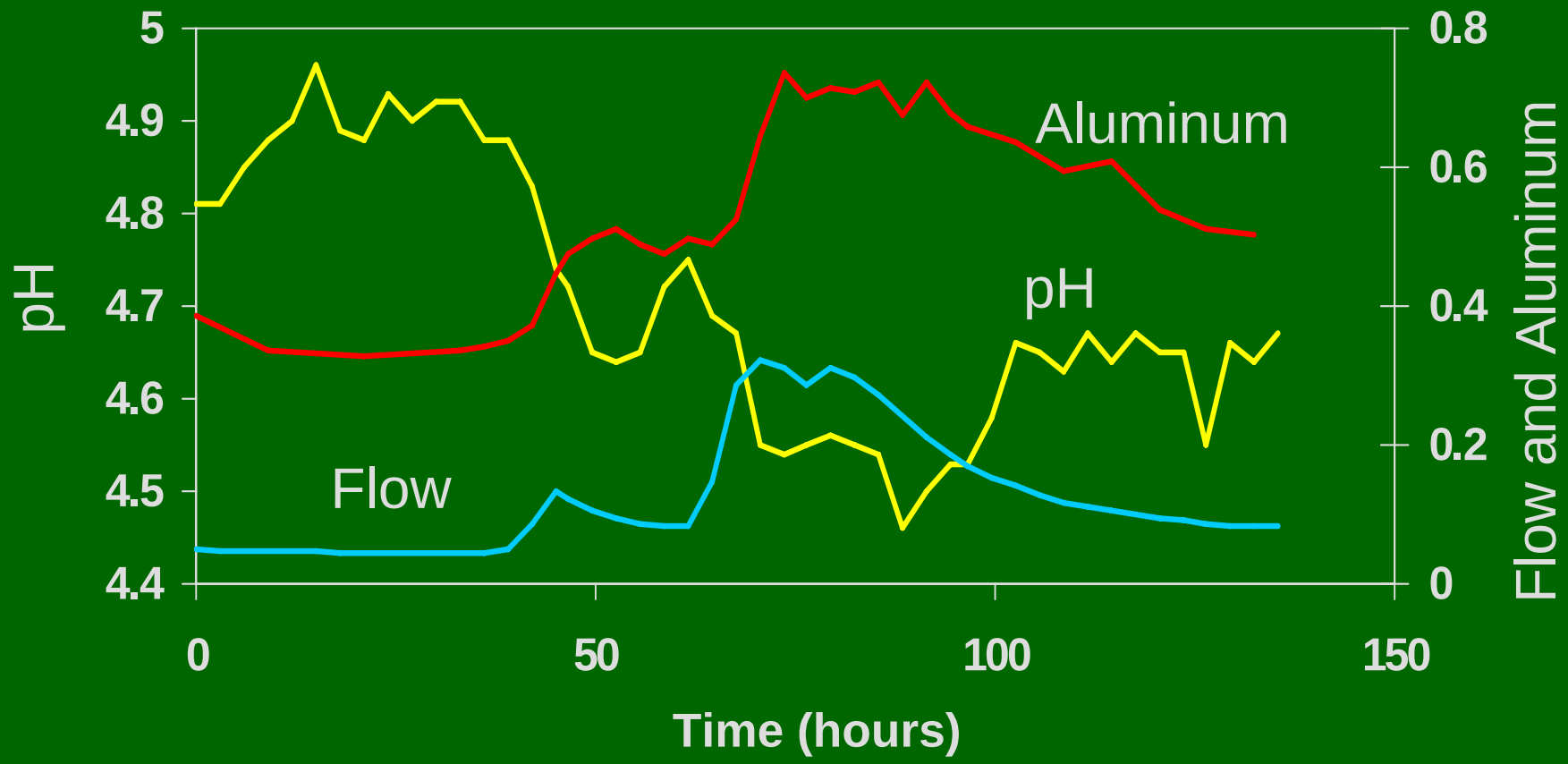


Hydrogen ion concentration as pH from measurements made at the field laboratories, 1998



National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu

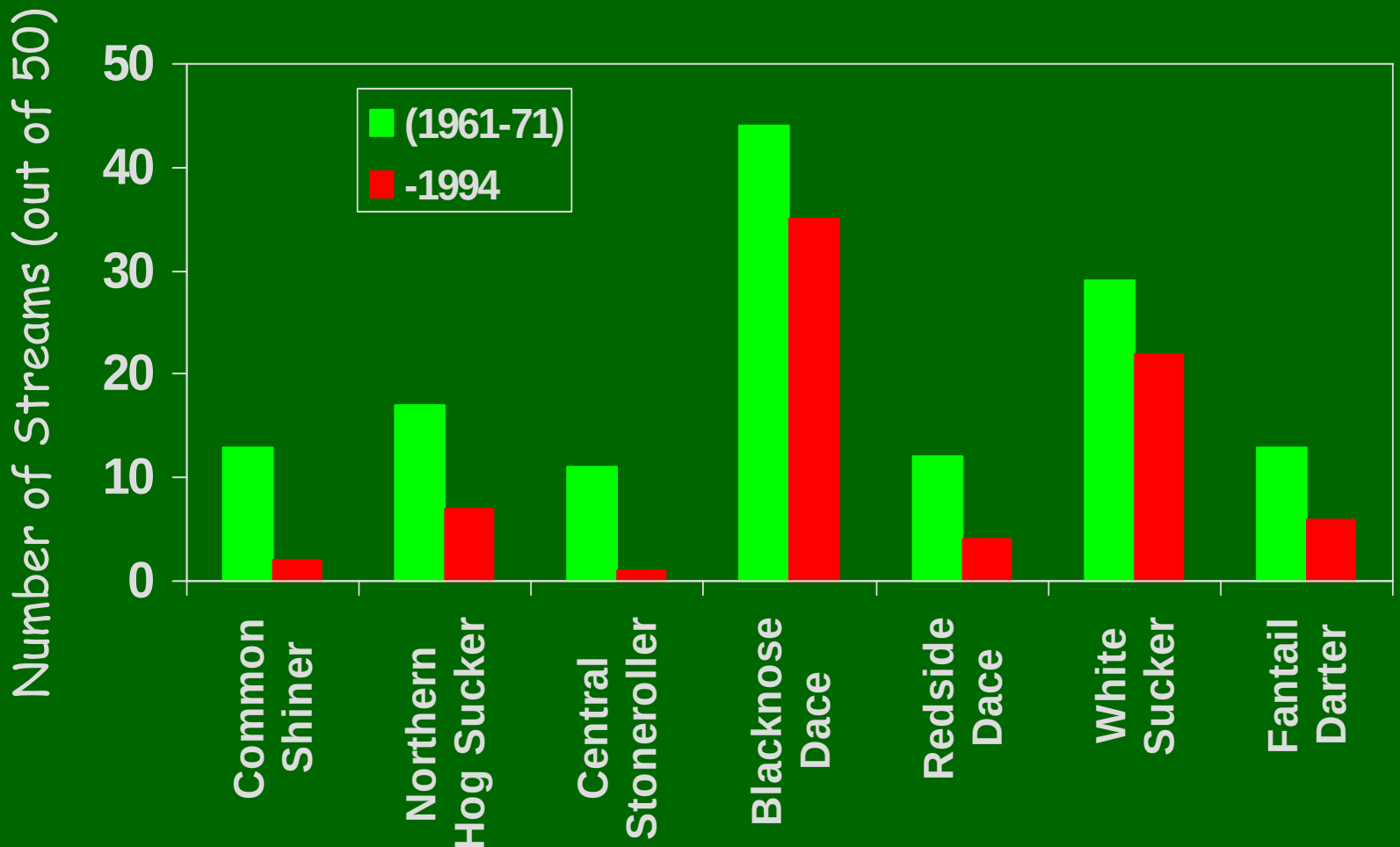
An Acid Episode



Effect on Streams

About 9,000 miles of streams in Pennsylvania are vulnerable to acid rain

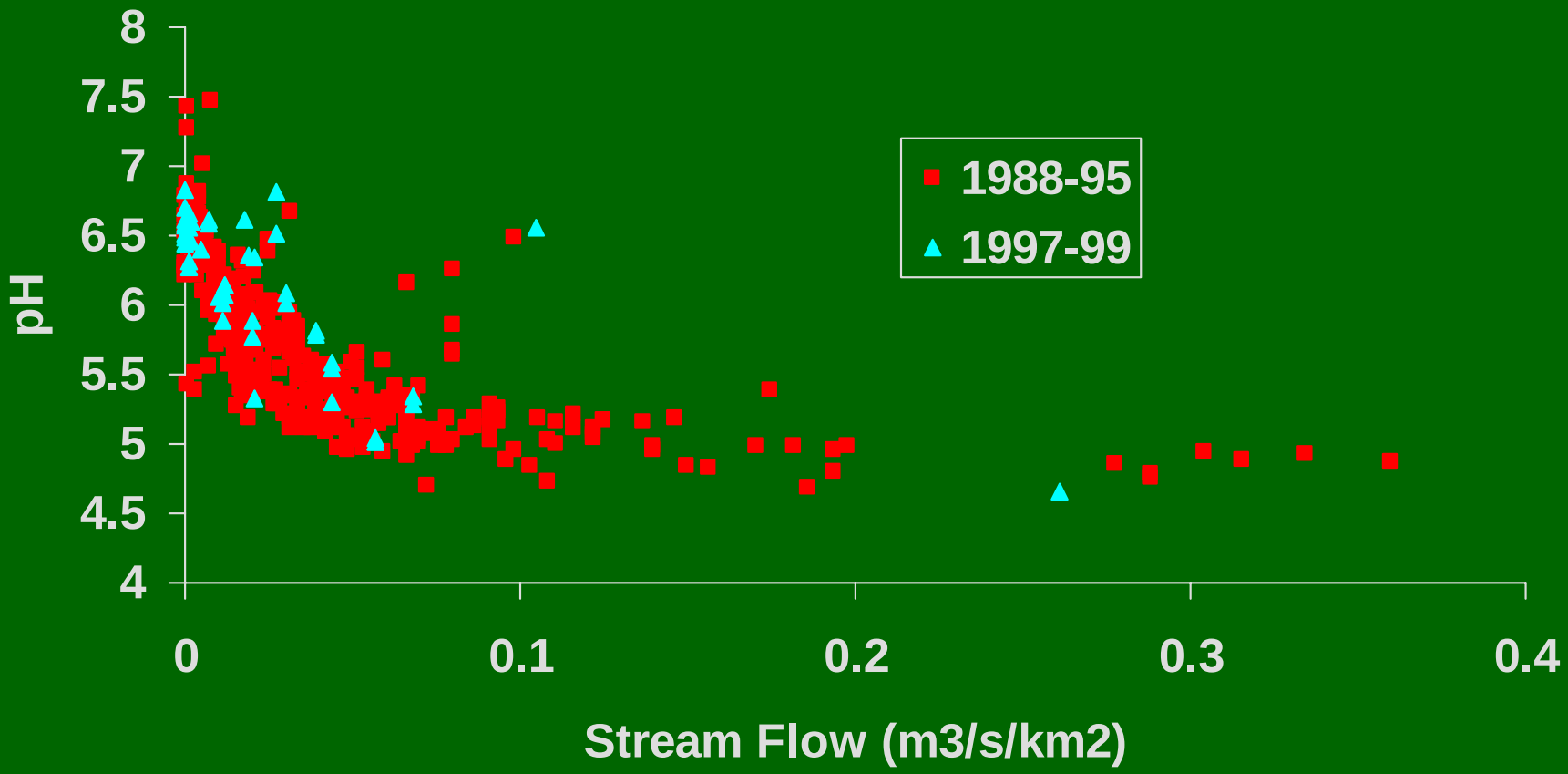
Loss of Fish Species Diversity



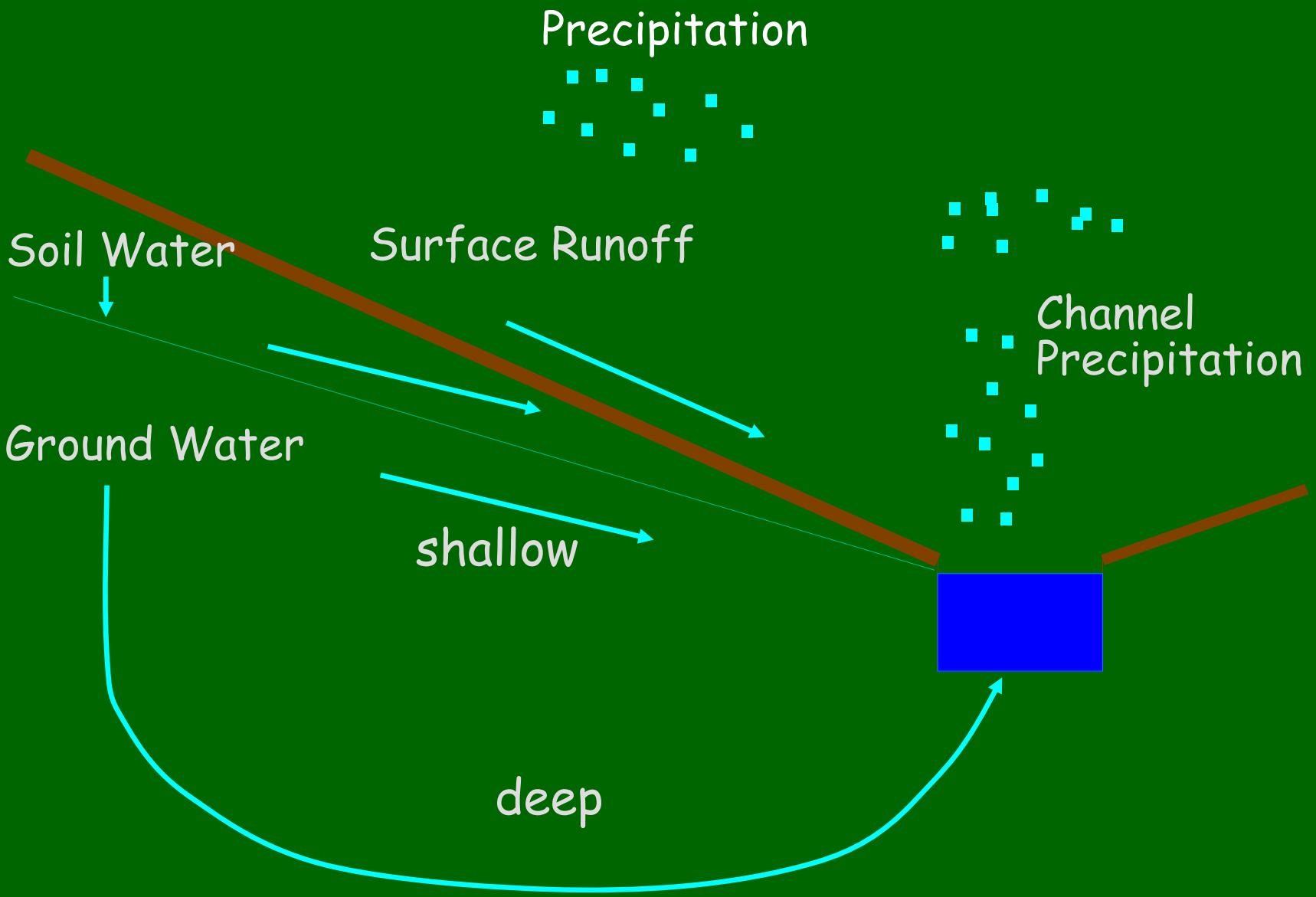
Effect on Fish

PA Fish and Boat Commission has changed trout stocking in 124 streams due to acid rain

1990 Clean Air Act Amendments Have Had Little Effect Thus Far!



Importance of Watershed Hydrology



Flow Source Chemistry

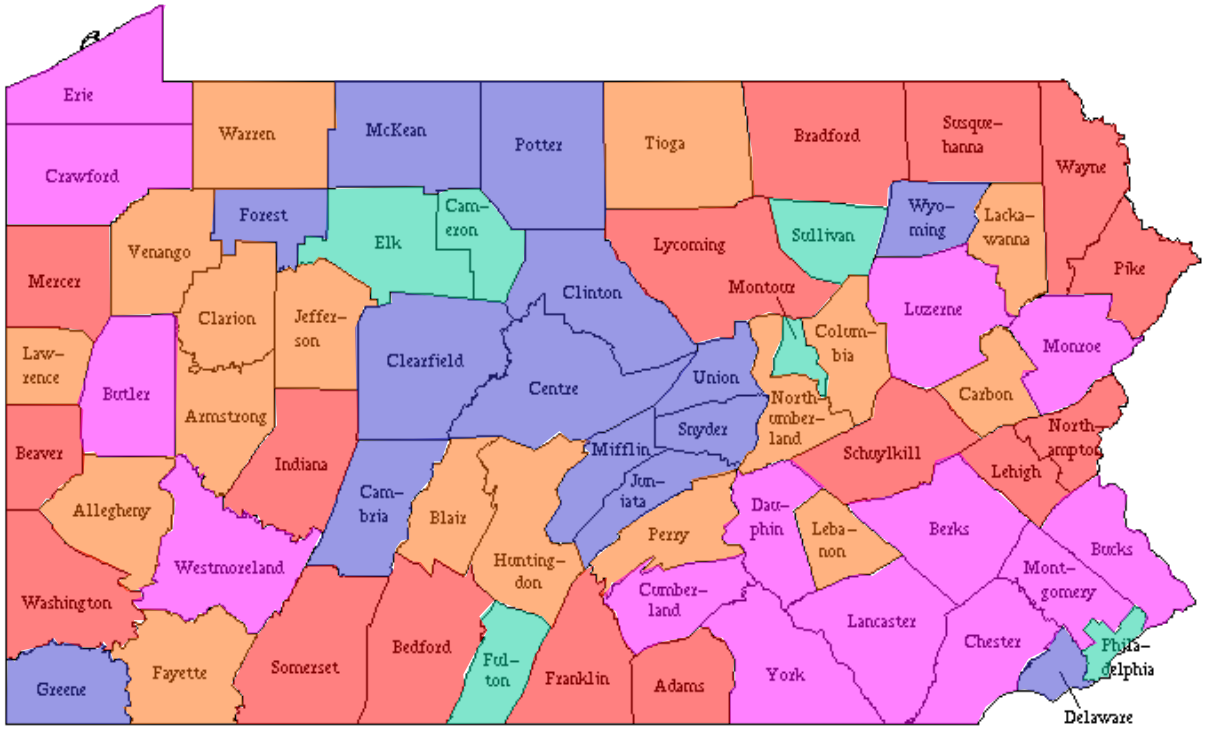
Source	pH	Al (ug/L)
Throughfall	4.29	3
Soil Water	4.45	1390
Groundwater	5.00	320
Peakflow	4.46	735

Public vs. Private Water Supplies

- Public
  - Serve approximately 8.4 million people in PA
  - Variety of groundwater and surface water sources
  - Routine water testing required
  - Required by law to meet drinking water standards
- Private
  - Serve approximately 3.6 million people in PA
  - More than 95% groundwater sources
  - Water testing and treatment are voluntary

Private Water Systems in Each County

1990 Census Data



Drinking Water Standards

- Primary
  - -Pollutants that cause health effect
  - -bacteria, heavy metals, pesticides, etc.
- Secondary
  - -Cause taste, odor, stains
  - -Iron, hydrogen sulfide, etc.

Setting Drinking Water Standards

- Carcinogen
  - -any exposure = risk (MCLG = 0)
  - -mathematical models calculate lifetime risk
  - -set MCL at 1 in 10,000 to 1 in one million risk
  - -consider treatment, detection, economic limits
- Non-Carcinogen
  - -calculate amount of chemical that person can be exposed to with no adverse lifetime effect
  - -assume 154 pound person, 2 liters of water per day,
    20% of exposure from water
  - -uncertainty factor built in (1 in 10,000)